Biologically Available Phosphorus Loading into Lake Tahoe

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Objectives

The goal of this project is to quantify bioavailable forms of phosphorus which are loaded to Lake Tahoe from stream sediment, urban and highway raunoff, atmospheric deposition, and dissolved organic P. Based on this information the loading budget for P will be updated to reflect BAP.

Develop Biologically Available Phosphorus Test

- Algal Bioassays for Validation of Chemical Methods

- Conduct concomitant algal bioassay experiments to verify validity of selected chemical extraction for BAP.

- *Selenastrum capricornutum* cultured in a phosphorus-free medium. The phosphorus associated with sediment contained in selected sediment samples, including ones from sediment traps in the Lake, will serve as the only source of phosphorus (Miller et al. 1978).

- Growth of algae is measured by chlorophyll and it assumed that the growth of algae is proportional to the amount of bioavailable-P (Cowen and Lee 1976).

- Quantified by the use of standard additions of known quantities of orthophosphorus to identical algal cultures for direct comparison (Ellis and Stanford 1988).

- evaluate the addition of a novel step, the microbial P released by lysis of cells by chloroform at time zero and the end of the incubation which when added to the inorganic P released to solution should be a direct measure of P taken up by cells.

Chemical Assays/Fractionation: Sediments and soil samples will be fractionated into several inorganic and organic P categories (Hedley et al. 1982):

- Ion exchange membrane extraction,
- chloroform fumigation/bicarbonate extraction.
- M NaOH extraction,
- M HCl extraction,
- perchloric/nitric acid digestion of residue.

- Each extract will be analyzed for inorganic and organic P extracted.

- Correlate with BAP from algal assay

Biologically available-P will be conducted on a total of 50 stream samples, 50 urban runoff samples, 30 atmospheric deposition samples, 20 lake sediment samples and 25, watershed soil samples.

Loading Rates and Fate of Biologically Available Phosphorus Entering Lake Tahoe

- Estimate BAP loading in discharge as it immediately enters Lake Tahoe ($BAP_{instantaneous}$).

- Provide research team that is conducting watershed modeling for Lake Tahoe with chemical data they need in order to estimate loading of instantaneously available BAP.

- Estimate BAP which could be released form the suspended sediment load as it settles to the lake bottom ($BAP_{ultimate}$).

- Both inorganic and organic forms of BAP related back to the material's totalP (μg P/mg dry weight)

- On 5 of the samples taken from sediment traps, PO_4 sorption/desorption isotherms will be determined in the presence of toluene to suppress biological uptake. Will provide data on the release/uptake of inorganic P as a function of particle concentration and PO_4 concentration.

- Mineralization rates of the organic P.

Sample collection

Sediment and water samples from the following sources:

- 5 streams (Upper Truckee River, General Creek, Ward Creek, Incline Creek, Edgewood Creek)
- Urban runoff
- Each primary designated land-use type
- Particulate matter from wet and dry atmospheric deposition (TRG)
- Watershed soils include: stream banks, overland flow channels, and road cuts and road sand

All samples will be collected on volcanic and granitic parent material.

Modelling

- Equations relating BAP released as a function of time (hours-weeks) developed for inclusion in the Tahoe Clarity Model.

- Equations for mineralization of the particulate organic P of the form will be provided as a rate constant times the concentration of particulate organic P.

- Langmuir equations for the sorption/desorption equilibria of inorganic P on particulate matter collected from sediment traps

- Temperature:, a Q10 relationship of 2 as supported by sources in the literature review (Task 3.2.2 above). The parameters of the Langmuir sorption equations will be related to temperature using well established Arrhenius relationships published for sorption on short range ordered iron and aluminum oxyhydroxides (using information collected in Task 3.2)

Evaluate Relationship of Particle Size with Biologically Available Phosphorus

- Fractionate P in separated particle size classes in 2 samples collected from sediment traps in the Lake

Exchangeable PO4 in Gondola Fire ash, soil, and runoff sediments

Origin	depth or layer	ug P / g soil
Soil on Burned Slope, plot 1	Charred litter	134
Soil on Burned Slope, plot 1	1-3 cm	46
Soil on Burned Slope, plot 1	1 cm	81
Soil on Burned Slope, plot 1	3-10 cm	64
Soil on Burned Slope, plot 2	1-3 cm	57
Soil on Burned Slope, plot 2	3-10 cm	28
Sediments in Riparian Zone	Silt deposit	144
Sediments in Riparian Zone	Coarser deposit	147

Representative range for granitic soils 20 to 70 ug/g soil (Susfalk 20000

Exchangeable PO4

Relative Fluorescence of Chlorophyll a

y = 1.45x + 7
R² = 0.79